AIRCRAFT WATER HEATING SYSTEM

[0001] This application claims the benefit of U.S. Provisional Application no. 60/412102, filed September 19, 2002.

Field of the Invention

[0002] This invention relates to water heaters and particularly to an electric water heating system for an aircraft or other applications in which similar requirements and limitations exist.

Background of the Invention

[0003] Heated water is customarily provided in commercial aircraft lavatories for hand-washing purposes. There are a number of requirements for such systems that place many limitations on the designs which can be satisfactorily employed. A suitable system should provide the needed heated water in as efficient manner as possible. The amount of electrical power needed for heating should be limited since aircraft attempt to minimize the amount so as to minimize the weight and cost of equipment. Likewise, the cost and weight of the water heating components should also be minimized. Related to costs, repair and replacement expenses are always of importance.

[0004] One widely used system accomplishes some of these goals but also has certain deficiencies. That system employs a tank containing two or more electrical heaters immersed in water. A major shortcoming of that system is that the water in contact with the heater is heated to a high temperature, possibly even boiling, with the undesirable consequence that calcification or other impurities form mineral deposits on the heater. Also this can be a concern due to overheating, creating a pressure vessel. The deposits are not good thermal conductors and hence additional power is required to heat the water. Further, the deposits hasten the need to replace the heaters or the entire unit. The container also has somewhat greater volume than is needed based upon usage analysis. The water heater containment vessel has to be designed and manufactured as a "pressure vessel" due to potential steam pressure. Additionally, unit cost is high.

Summary of the Invention

[0005] Briefly stated, the invention provides a compact water heating system for intermittent, small volume usage, such as for aircraft wash basins or similar applications. The system employs a tube, preferably coiled, and an electric heater in good heat transfer relation with the tube. Since the volume demand is small and intermittent for typical aircraft wash basin usage, and the water temperature desired is relatively low, no large reservoir of high temperature water is needed.

Brief Description of the Drawings

[0006] Fig. 1 is a schematic, perspective view of one embodiment of a water heater system.

[0007] Fig. 2 is a plan view thereof.

[0008] Fig. 3 is a schematic, perspective view of another embodiment of a water heater coiled around a sink basin.

[0009] Fig. 4 is a plan view of the heater of Fig. 3.

[0010] Fig. 5 is a schematic, perspective view of another embodiment of the invention.

[0011] Fig. 6 is a plan view of the embodiment of Fig. 5.

Detailed Description of the Preferred Embodiment

[0012] Referring to Fig. 1, there is illustrated a water tube 10 coiled in a relatively tight spiral creating a series of coils. An electrical heater 12 adjoins the tube in good heat conductive fashion. For example, the heater may be brazed to the tube or joined by a good heat conductive epoxy. The heater preferably extends along most of the length of the tube coils to efficiently heat the water in the tube. The heater may be any readily available electric tubular heater having a resistance heating element surrounded by electrically insulating, heat conductive material. The heater is connected to a suitable source 14 of electric power, and a temperature responsive switch 16 to limit the maximum water temperature.

[0013] The water tube is preferably made of copper or stainless steel or another thermal conducting and potable water compatible material. Stainless steel is a good thermal conductor. It is non-contaminating to water and is not corroded by water. Stainless steel is

very durable, and is also very ductile so that it can be formed to fit into space-saving configurations. This, of course, is very important for aircraft usage where minimizing space needs is very important. The tightly curved tube illustrated in Figure 1 is a relatively compact structure and does not take a large amount of space. For example, the coil diameter may only be three or four inches. On the other hand, because stainless steel or copper is easily formed, a heater 20 can be positioned around the lower portion of a sink basin 22, for example, as is illustrated in Figures 3 and 4, wherein the water heater may occupy space that is otherwise not used. The overall design is simple and long-lasting.

[0014] Another advantage of the system illustrated is that the length of tubing required is not very great in that the water usage demands are very low. Typically, aircraft lavatories have an automatic shut-off of the water supply 4 to 6 seconds after the user pushes the water dispensing button on the faucet. A typical user will push the button twice while washing hands to obtain two short bursts of water. In most aircraft systems, this is less than a pint and it is believed that only about 11 ounces is needed. It has also been found that a typical interval between users of an aircraft lavatory sink is seldom less than three minutes. In other words, it is only necessary to supply about 11 ounces of heated water about every 3 minutes.

[0015] Also, the system is not so much a hot water system as it is a warm water system. That is, the temperature of the water coming out of the tap for current systems is no more than about 115°F. It has been found that with the above-described heater, it is only necessary to employ a short length of tubing with the corresponding heater joined to it. The volume of water stored within the tube is sufficient to satisfy the needs without a separate storage container, that is, most of the heated water is depleted by a single user. That amount of unheated water is then heated to the necessary temperature within about three minutes. Note that the unheated water is typically already about 60°F.

[0016] More specifically, the parameters of a prototype system that satisfies typical aircraft needs employs about 74 inches of tubing with the corresponding length of electrical heater bonded to the tubing. The tubing external diameter is about ¾ inch while the tubing wall thickness is about 1/32 inch. The power required to heat 60°F water to about 115°F is approximately 400 watts. A system of that size provides about 14 ounces of water.

[0017] Minimizing electrical demands is of course also important on an airplane so as to minimize the cost and weight of power-generating equipment and to minimize the necessary fuel to produce the power. To further minimize electrical consumption and thermal losses, the heating coil may be insulated with a suitable lightweight insulating material. Further, the coil bundle can be encased in another enclosure 24 (Fig. 1) that helps conserve heat and protects the heater from its surroundings. The switch 16 and other electrical controls can be positioned within the coil bundle shown in Fig. 1.

[0018] The heater 12 is schematically illustrated in the drawings with each of its coils positioned in the recess formed between adjacent tube coils in intimate relation with those two coils. The heater coils are shown extending around the exterior of the tube coils, but the heater coils could be on the interior of the tube coils, as shown in Fig. 5. Also any electric controls could be positioned within the tube bundle, as shown in Fig. 6.

[0019] This heating system does not fall into the category of a "pressure vessel." Thus it results in a safe and economical approach.

[0020] This design promotes easy maintenance and cleaning. The water heater can be chemically cleaned in situ or can be cleaned with a brush without having to disassemble the water heater assembly.

[0021] While the invention has been shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.